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# THE FRENCH TURPENTINING SYSTEM APPLIED TO LONGLEAF PINE

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*Great and irreparable damage is being done to the second-growth longleaf pine in parts of the South by destructive turpentining methods. This circular sets forth experiments carried on for six years in the Florida National Forest. The results of these experiments indicate that the second-growth longleaf pine can be worked profitably under the French system of turpentining, and that, for the permanent welfare of the naval-stores industry of the South, operators in second-growth forests would do well to adopt the governing principles of the French system.*

## INTRODUCTION

The naval-stores industry of the Southern States dates back to colonial times, and subsequent to the Civil War it has held a place among the industries of the South inferior only to agriculture and lumbering. Since 1820, or, in fact, since statistics of any value became available, American production of naval stores has led the world, and even now is nearly 70 per cent of the total world production.

So pronounced, however, is the depletion of the timber upon which our naval-stores industry depends that the industry is commonly regarded as a dying one. Steps should be taken in the immediate future to work conservatively the remaining supply of virgin timber and to adopt a method of turpentining the second-growth timber that will insure a profitable yield over a long period of years while it is maturing. Otherwise, we can look forward only to a steady decline in production, with definite indications that another decade will see the gum naval-stores industry in the South forced to seek new fields for its supply of timber.

Contrast this situation with that of the industry in France, where the output of naval stores has been growing steadily for more than 80 years and where it is still increasing yearly in amount and value, with little or no reduction in the timber supply. The answer is the use in France, both by private owners and by the Government, of a system of turpentining based upon the scientific development of the idea that a pine tree can be profitably worked for turpentine over the major portion of the time it is growing to saw-timber size.

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The approaching shortage in the South of longleaf and slash pine available for naval-stores operations makes of great interest the possibility of using this French system or some modification of it in our own pineries and thus giving a new lease on life to our gum naval-stores industry.

Under the French system, a forest area is profitably worked for turpentine during a period of from 30 to 50 years (fig. 1), with short intervals of rest, without materially reducing the saw-timber value of the trees. An American operation, on the contrary, is very short-lived, by far the greater part of the timber being worked not more than 5 or 6 years and much of it only 3 years before it is cut for saw timber.

Prior to 1915 the French method of cupping and chipping had not been tried on longleaf pine on a commercial scale. As a possibility to be considered for application to Government timber, now or in the

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FIG. 1.—A turpentine orchard in the Landes, France. Maritime pine

future, the Forest Service of the United States Department of Agriculture desired to try it out carefully, under commercial conditions. Accordingly, arrangements were made in 1915 for the experiment, the results and history of which are set forth in this circular.

The original experiment was undertaken not as a part of the strictly scientific research activities of the Forest Service, but rather as a feature of the administrative plan for the western division of the Florida National Forest, where the extensive Government holdings of longleaf pine timber lands made essential the development of a commercially sound and yet conservative standard practice in turpentining.

The plan was conceived and inaugurated by Forest Inspector I. F. Eldredge, at that time supervisor of the Florida Forest. The writer has been continuously in direct charge of the operations from their initiation in 1915.

## OBJECTS OF THE EXPERIMENT

It was desired to ascertain (1) by actual operation over a period of years long enough to give a reasonably safe average, what flow of gum, as compared with that under the regular Government method, would result from the French method; (2) what effect the French system would have upon the trees; and (3) by a practical commercial operation on a small scale, whether or not the French method could be applied profitably by a typical American naval-stores operator with an average plant and the ordinary grade of turpentine labor using French tools.

## PLAN OF OPERATION

A cooperative agreement was entered into by the Forest Service with the Garniers Turpentine Co., of Garniers, Fla., to operate for naval stores the Government timber in section 28, township 1 south, range 23 west, Tallahassee base and meridian (fig. 2), according to

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FIG. 2.—Best Government timber in Florida National Forest. Near East Bay Ranger Station. Longleaf Pine

specifications to be laid down by forest officers. The company furnished and directed the labor in putting up the cups, chipping the faces, dipping and hauling the gum, and raking the trees. A forest officer inspected the work each week during the season and weighed and recorded the dip and scrape.

The 640-acre tract contains a pure open stand of longleaf pine, typical of the timber in this division of the Florida National Forest. The ground is level, without streams or swamps. The trees average 12 inches in diameter breast high and run 26 trees per acre over 8 inches in diameter. The stand is old and is considerably below the average quality of longleaf pine stands in the South. The soil is a deep white sand with no hard-pan or clay subsoil. The area lies about 3 miles north of the north shore of Choctawhatchee Bay. The section was divided, as shown by the sketch map (fig. 3),

into four 160-acre "drifts." The age, size, and quality of the timber is practically the same in the four drifts.

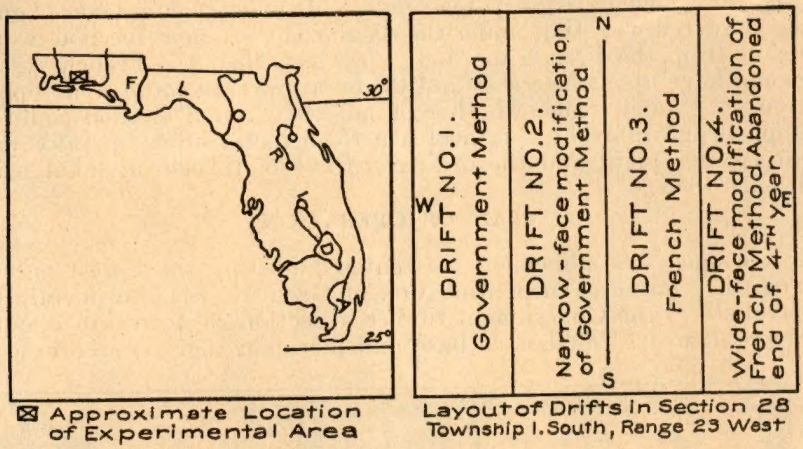


FIG. 3.—The experimental area

*Drift No. 1* was cupped and chipped according to the regular Government method prescribed in the leases to commercial turpentine operators throughout the Florida National Forest. No trees

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FIG. 4.—Drift No. 1. Government method during first season. Eleven streaks on faces 9 inches wide

below 10 inches in diameter 4½ feet above the ground were cupped; not more than one cup was placed on trees 10 to 16 inches in diameter;

not more than two cups on trees 17 to 24 inches in diameter, and not more than three cups on any tree. The McCoy metal cup and horizontal apron were used. The cup was placed as near the ground as possible, the first streak being chipped at the time the apron was installed and placed within 3 inches of the apron. Cups were so placed on the two-cup trees that an 8-inch bar of uncut wood was left between faces. Chipping and pulling was done with No. 0 hacks and pullers; depth and height of streak did not exceed one-

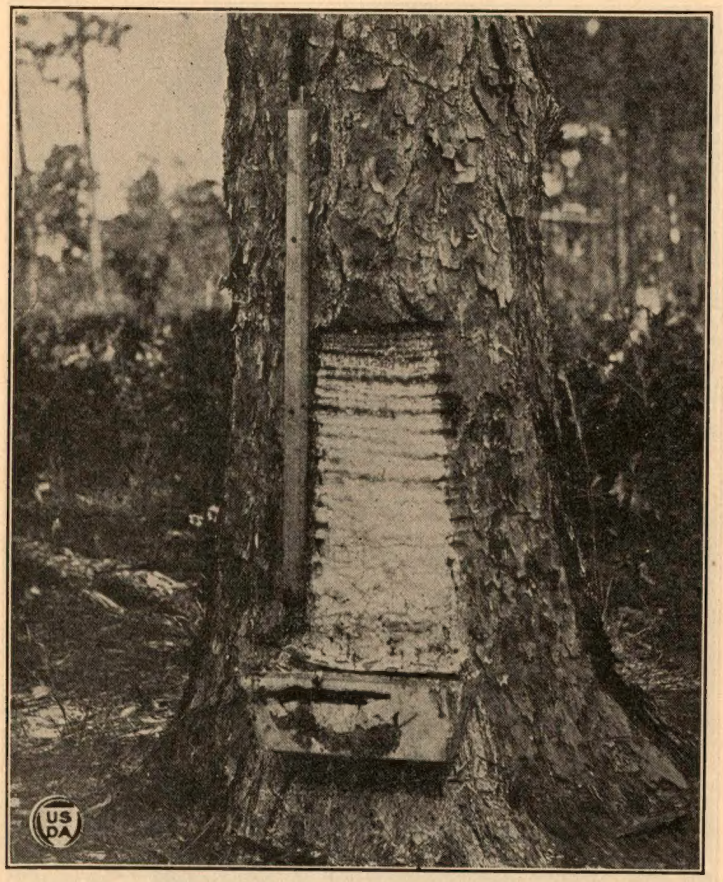


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FIG. 5.—Drift No. 2. Narrow-faced modification of Government method at end of first season. Faces averaged 6 inches wide

half inch. During the six years' operations 20 streaks were lost. Faces averaged 8.9 inches wide (fig. 4).

*Drift No. 2* differed from the regular Government method in that smaller trees were cupped and the faces were narrower. No trees below 8 inches in diameter 4½ feet from the ground were cupped; not more than one cup was placed on trees 8 to 12 inches in diameter; not more than two cups on trees 13 to 17 inches in diameter, and not more than three cups on any tree. On two-cup trees the cups were placed on opposite sides of the tree, and on three-cup trees

they were equidistant around the tree. All other conditions of cupping and chipping were the same as under the regular Government method, except that the faces were only 6 inches wide. During the six years 24 streaks were lost (fig. 5).

*Drift No. 3* was cupped and chipped strictly in accordance with the French specifications. No trees below 8 inches in diameter 4½ feet from the ground were cupped; not more than one cup was placed on trees 8 to 12 inches in diameter; not more than two cups

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FIG. 6.—Drift No. 3. French method at end of first season. Scrape not removed. Faces averaged 3½ inches wide

on trees 13 to 17 inches in diameter, and not more than three cups on any tree. On two-cup trees cups were placed on opposite sides of the tree, and on three-cup trees they were equidistant around the tree. All tools used in this drift were the regulation French turpentine tools imported for the purpose. The first operation in cupping was to thin the bark for the first season's work. A groove-like face 3½ inches wide and 7 inches up the tree was then chipped, a circular gutter inserted, and a Herty clay cup hung under the

gutter. In regular chipping the streak was one-half inch deep in the center, tapering to a feather edge, and was frequently five-eighths inch high. During the six years' experiment 26 streaks were lost (fig. 6).

*Drift No. 4* was cupped and chipped somewhat according to the French system, but with wider faces. The same diameter limits were observed in determining the number of cups to be placed on a tree, and French tools were employed. The regular French method

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FIG. 7.—Drift No. 4. Wide-face modification of French method at end of first season. Scrape not removed. Faces 8 inches wide

of operation, however, was departed from to the extent that the faces were made 6, 8, and 10 inches wide instead of the 3½-inch width commonly used. In addition, the first faces were chipped 10 inches high to start with, and a horizontal cup and apron were used. Owing to the difficulty in chipping the high, wide faces with the French tools, this modification of the French method was abandoned at the end of the fourth year. During the four years 25 streaks were lost (fig. 7).

## HISTORY OF THE EXPERIMENT

The cupping on the experimental area was begun on March 8, 1915, in drift No. 1, under the Government method. The drifts were cupped in regular sequence, the work being completed on April 7 in drift No. 4, under the wide-face modification of the French method. Drifts Nos. 1 and 2 were cupped with the regular American tools; French tools employed in commercial operations in France were used in drifts Nos. 3 and 4. The first streak was chipped in all drifts at the time cups were installed, and an interval of three weeks elapsed before regular chipping was begun.

When the first French drift was reached it was necessary to reorganize the cup crew according to their aptness in mastering the use of the French tools. However, after a short time had been spent in working out the assignments to the men to the parts of the work for which they were best fitted, the cupping proceeded satisfactorily. It was found that the French method of placing cups was easier than the regular Government method; the number of cups installed and the cost per cup were practically the same.

In drift No. 4 cupping proceeded somewhat slowly on account of the necessity of chipping a much larger surface for the first face.

The cups were moved up twice during the operations in all the drifts—at the end of the first, and again at the end of the third season's work.

During the first four years of the experiment labor was scarce and unstable, and it was frequently necessary to break in new chippers. This materially affected the work in the two French drifts, where a new man usually had to chip two streaks before he became adept in the method and in the use of the French tools. In chipping under the French method approximately one half inch of new wood is taken from the upper side of the face and the old face is renewed, center and edge, downward 3½ inches. The tendency of an untrained chipper is to square, more or less, the oval peak. This means that the desired featherlike edge of the streak can not be obtained without exceeding the width limit of the face. Unless overcome, this tendency results in a lower yield from the new streak on account of the small area of freshly chipped surface.

Three severe West Indian hurricanes occurred during the life of the operations—two in 1916 (in July and October) and the third in October, 1918. The duration and severity of these hurricanes caused a considerable reduction in yield during the years 1916, 1917, and 1918, and about the time the timber regained its productive powers in 1920 a heavy mast crop caused another falling off.

In order that a correct record of the yield from the experimental area might be kept, 24 dip barrels were set aside and used exclusively for the experiment. Six barrels were allotted to each drift, the barrels being numbered and painted a different color for each drift.

The operations were inspected at least once each week by a forest officer, who saw that the specifications of the experiment were complied with, recorded each streak chipped, and weighed and recorded the dip and scrape after it reached the still.

## ANALYSIS OF RESULTS

Table 1 shows the number of faces that can be worked on a given area under the different methods employed in the experiment, and the yield of crude turpentine gum that can be obtained on an area basis. Of chief interest is the comparision of yield obtained by the regular Government method with that obtained by the French method. The methods employed on drifts Nos. 2 and 4 are merely modifications of the two methods around which the experiment was centered. Drift No. 4 was abandoned at the end of the fourth season's work because the method was not adapted to high faces.

The age, size, and quality of the timber is practically the same on all four of the drifts. The average number of faces per tree is about the same, and the difference in number of faces per drift is largely due to the different cupping diameter limits imposed. Total heights of French faces are greater because 7-inch faces were chipped at the beginning of the operation, and also because, in chipping, a little in excess of one half inch of new wood was frequently taken from the upper side of the face.

Table 1 shows that six more streaks per face were chipped on the Government drift than on the French, but that the actual yield of the French drift is 46 per cent (approximately 30 barrels of spirits) greater. The increase is due to the fact that it was possible to work more faces on an equal acreage under the French method.

TABLE 1.—*Summary of the experiment and its results*

| | Drift No. 1, Government method | Drift No. 2, narrow-face modification of Government method | Drift No. 3, French method | Drift No. 4, wide-face modification of French method |
|---|---|---|---|---|
| Area in drift—acres | 160 | 160 | 160 | 160 |
| Number of trees cupped | 2,184 | 3,622 | 5,341 | 3,640 |
| Number of cups placed | 2,395 | 4,675 | 6,385 | 4,024 |
| Average number of faces per tree | 1.2 | 1.3 | 1.2 | 1.1 |
| Average width of faces—inches | 9 | 6 | 3½–4 | 8 |
| Height of faces at end of sixth year—inches | 79 | 80 | 104 | (1) |
| Total number of streaks per face | 172 | 168 | 166 | 107 |
| Number of seasons worked | 6 | 6 | 6 | 4 |
| Actual total yield: | | | | |
| Pounds of dip | 87,745 | 120,657 | 117,980 | 74,255 |
| Pounds of scrape | 20,670 | 29,620 | 40,530 | 20,460 |
| Total | 108,415 | 150,277 | 158,510 | 94,715 |
| Total yield per crop [2] in pounds of dip and scrape on basis of 32 streaks per season on all drifts | 508,300 | 366,800 | 288,800 | 286,600 |
| Average annual yield of spirits of turpentine per crop on basis of 32 streaks per season on all drifts—casks | 40.5 | 29.3 | 22.4 | (1) |

[1] Abandoned at end of fourth year.

[2] A "crop" is 10,000 cups.

As may be seen from Table 1, the percentage of scrape from drift No. 3, French method, was considerably higher than from either drifts No. 1 or No. 2. This was largely due to the higher faces over which the gum had to flow to reach the cups, particularly during the last two years of working, and to a less extent to the heavy rainfall in the same two years.

The number of casks of spirits given at the bottom of Table 1 does not represent the actual yield from the different drifts, but is an estimate of yield from a crop of 10,000 faces based on the same rate of production as was actually secured on the experimental areas.

On the basis of yield per crop the Government method (drift No. 1) shows better results on account of the working of a larger surface of

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FIG. 8.—Drift No. 1. Government method. Height at end of sixth season indicated by caliper. Faces averaged 79 inches high and 9 inches wide

face, and on a crop basis the yield is 76 per cent greater than by the French method. However, this seemingly large increase is more than offset by the increase of 168 per cent in acreage necessary to obtain it. These faces can be worked for 2 years more, which will exhaust

their productive value, and then the timber can be back-cupped and worked under the Government system 6 or 7 additional years (fig. 8). The turpentine value of the timber will then have been exhausted and a new crop of timber will have to be grown before the area can again be turpentined.

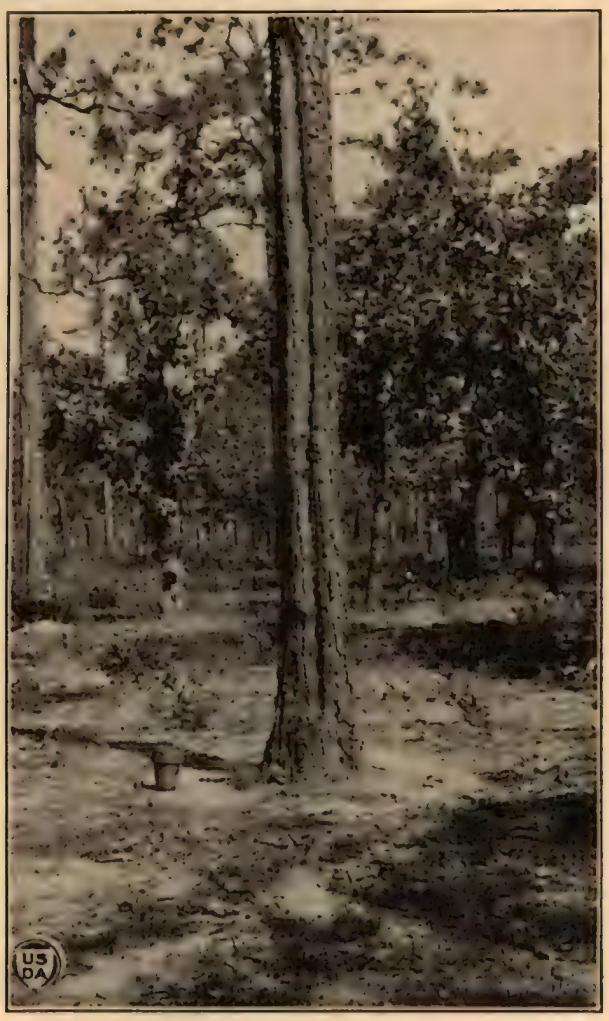


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FIG. 9.—Drift No. 3. French method at end of sixth season. Faces averaged 104 inches high and 3¾ inches wide. Note face growing over at bottom

On the basis of yield per acre the French system shows better results, with an increase of 52 per cent in production over the Government system. (See Table 2.) This is due to the fact that trees of smaller diameter can be worked without damage and with profit, thus increasing considerably the number of producing faces. On timber of practically the same density of stand the French method

gave 39.90 cups per acre and the Government method 14.95 At this rate 250 acres will cup a crop of French faces, as against 670 acres under the regular Government method. In contrast to the Government drift, the French drift can be worked over several additional periods, each being as productive, or more so, than the first, and during all this time the smaller trees will maintain their growth. Nature's processes of healing over the first faces will be well under way (fig. 9).

TABLE 2.—*Yield per acre in pounds of dip and scrape. On basis of 32 streaks each year on each drift*

| Season | Drift No. 1, Government method | Drift No. 2, narrow-face modification of Government method | Drift No. 3, French method | Drift No. 4, wide-face modification of French method |
|---|---|---|---|---|
| 1915 | 143.27 | 170.94 | 269.39 | 228.61 |
| 1916 | 125.73 | 173.86 | 140.88 | 139.83 |
| 1917 | 127.82 | 219.73 | 153.25 | 162.47 |
| 1918 | 115.11 | 138.21 | 177.60 | 188.88 |
| 1919 | 130.51 | 213.89 | 237.46 | (1) |
| 1920 | 116.46 | 155.16 | 174.01 | (1) |
| Total, 6 years | 758.90 | 1,071.79 | 1,152.59 | [2] 719.79 |
| Average, 6 years | 126.48 | 178.63 | 192.10 | [2] 179.95 |
| Average number of cups per acre | 14.95 | 29.22 | 39.90 | 25.15 |

[1] Abandoned.

[2] Four years.

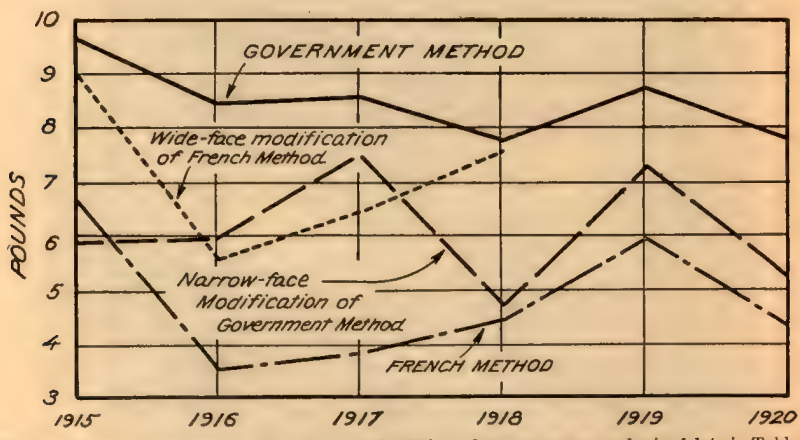


FIG. 10.—Graphic presentation of yield in pounds of dip and scrape per cup on basis of data in Table 3

Table 3 shows that the seasons of 1916 and 1917 were the lowest in point of production for the French drift. (See also fig. 10.) This is attributed to natural causes, such as are encountered in all operations, and not to the method employed. The hurricanes in 1916, before mentioned, with an unusual amount of rainfall, interfered with the regularity of chipping; and the scarcity of labor, irregular chipping, and breaking-in of new chippers had its influence on production in the 1917 season. However, with more regularity in chipping the following season showed an increase in production. A French face is chipped with a slab streak and is, therefore, responsive to regular work.

By referring to Table 4 it will be seen that, on the basis of yield per square inch of surface worked, the difference between the yields is small. But this would not hold true had wide faces been chipped under the small diameter limits used in the French drift. Had this been done the Government system would have shown a decrease in yield.

The most important lesson learned from the French method is that the chipping surface should not be increased in order to procure a greater yield, which is certain to be only temporary, and which will involve early exhaustion of the tree.

The experiment demonstrated clearly that, because trees of small diameter can be used without injury under the French method, the yield on an acre basis is considerably greater than under the Government method.

The tryout of the French system of cupping, while carried on for only 6 years, gave every reason to believe that our longleaf and slash pine second-growth timber can be profitably worked for fully as long a time as the French work their maritime pine—30 to 40 years—without materially reducing its vigor and growth.

TABLE 3.—*Yield per cup in pounds of dip and scrape. Reduced to basis of 32 streaks each year on each drift*

| Season | Drift No. 1, Government method | Drift No. 2, narrow-face modification of Government method | Drift No. 3, French method | Drift No. 4, wide-face modification of French method |
|---|---|---|---|---|
| 1915 | 9.65 | 5.85 | 6.75 | 9.09 |
| 1916 | 8.41 | 5.95 | 3.53 | 5.56 |
| 1917 | 8.55 | 7.52 | 3.84 | 6.46 |
| 1918 | 7.70 | 4.73 | 4.45 | 7.55 |
| 1919 | 8.73 | 7.32 | 5.95 | [1] |
| 1920 | 7.79 | 5.31 | 4.36 | |
| Total | 50.83 | 36.68 | 28.88 | 28.66 |
| Average, 6 years | 8.47 | 6.11 | 4.81 | [2] 7.17 |

[1] Abandoned. [2] Average, 4 years.

TABLE 4.—*Actual yield per square inch of face exposed, in pounds of dip and scrape*

| Season | Drift No. 1, Government method | Drift No. 2, narrow-face modification of Government method | Drift No. 3, Franch method | Drift No. 4, wide-face modification of French method |
|---|---|---|---|---|
| 1915 | 0.0715 | 0.0631 | 0.0599 | 0.0328 |
| 1916 | .0624 | .0669 | .0544 | .0364 |
| 1917 | .0664 | .0846 | .0591 | .0506 |
| 1918 | .0616 | .0515 | .0653 | .0543 |
| 1919 | .0709 | .08 3 | .0829 | [1] |
| 1920 | .0539 | .0552 | .0599 | [1] |
| Total, 6 years | .3867 | .4036 | .3815 | [2] .1741 |
| Average, 6 years | .0644 | .0673 | .0636 | [2] .0435 |

[1] Abandoned. [2] Four years.

The loss of cups under Government methods of chipping, as shown in Table 5, is very low as compared with private operations. This was brought out vividly on a section adjoining the experimental area, where the loss on a private operation exceeded 50 per cent and so lowered the productivity of the remaining trees that the operation had to be abandoned during the fourth season's work on account of the unprofitable yield.

A further study of Table 5 shows considerably smaller loss under the French method than that under the regular Government method. Of the methods under consideration, the wider faces show a higher rate of loss in proportion to the exposed surface than do the narrow ones.

Final analysis will show that the loss in the French drift, where the greater part of the timber is overmature, decadent, and not the class of timber best suited for the method, is not appreciably greater than should be expected from natural causes, such as lightning, wind, disease, and insects.

The French system is better adapted to young second-growth timber, and on such an operation death caused from chipping would be practically eliminated. Owing to the narrowness and smooth featherlike edge of the French face, the process of healing over takes place very rapidly. (See fig. 9.) Considering the manner in which the old, slow-growing timber on the experimental area healed, it is believed that with young, thrifty timber complete healing over would take place in 10 or 12 years.

TABLE 5.—*Shrinkage or loss in number of cups in five years' working*

| | Drift No. 1, Government method | Drift No. 2, narrow-face modification of Government method | Drift No. 3, Franch method | Drift No. 4, wide-face modification of French method |
|---|---|---|---|---|
| Cups placed in 1915 | 2,395 | 4,675 | 6,385 | 4,024 |
| Cups counted in 1920 | 2,240 | 4,442 | 6,083 | [1] |
| Loss | 155 | 233 | 302 | ---------- |
| Per cent of loss | 6.5 | 5.0 | 4.7 | ---------- |

[1] Abandoned at end of fourth year.

## COMMON LABOR AND THE FRENCH SYSTEM

Six years' trial of the French system of turpentining has demonstrated conclusively that expertness in chipping is much more quickly and easily acquired than under the American system, as the free-hand stroke with which the American streak has to be chipped is not used (fig. 11).

Ordinary labor can become proficient in French chipping in a very few days, whereas under the American system it generally takes a season or more to acquire ability to chip a smooth streak at a specified depth and height. A chipper can chip practically the same number of French faces in a working day as he can under the American system. On an extensive operation laborers would readily adapt themselves to the different phases of the French method of turpentining.

## CONCLUSIONS

From the experience gained on this operation it may be concluded that mature longleaf pine and slash pine can best be turpentined

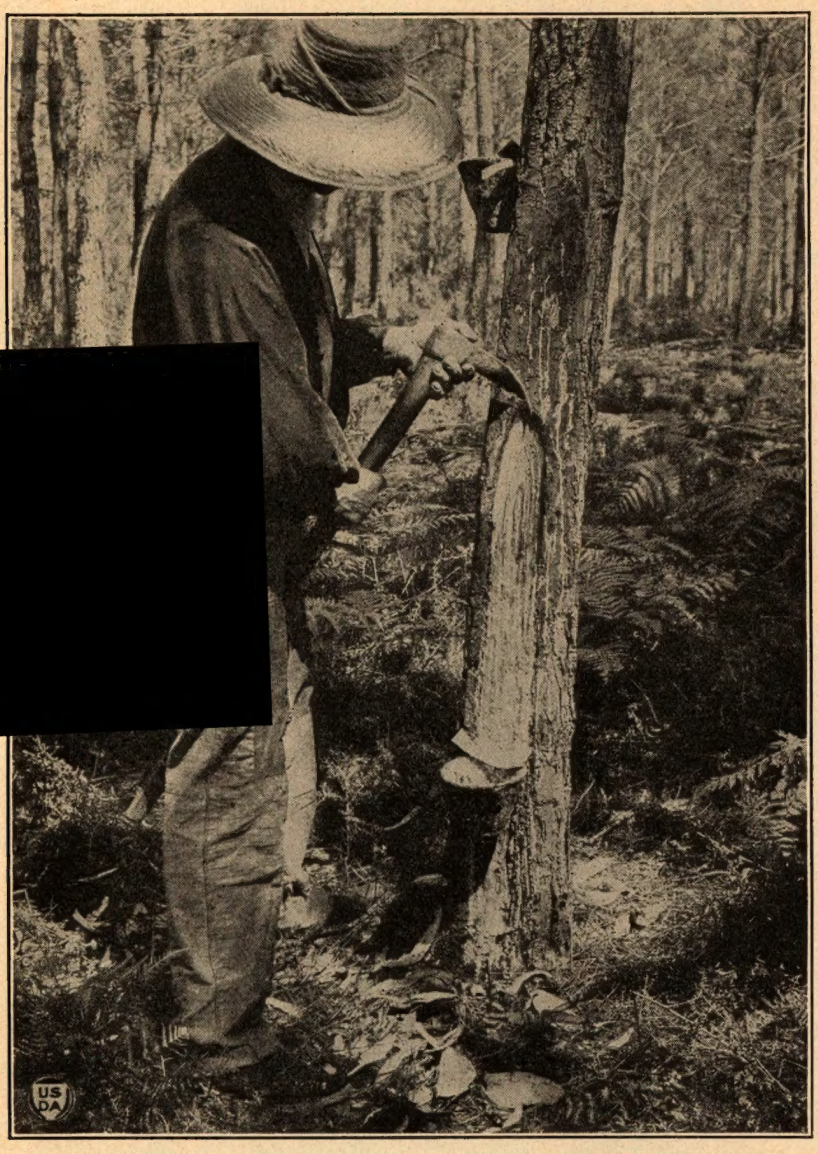

FIG. 11.—Turpentining in France. Chipping during the second season, showing the shape of the French hack and the relative size of the face. Note size and shape of chips on the ground

under the present Government method of cupping and chipping, which permits profitable working for 14 years without damage, and that second-growth longleaf and slash pine under saw-timber size can be more profitably worked under the French system, because

this system allows a much longer operating period, during which the tree continues to thrive and grow until it becomes ready for saw timber.

The yield per face under the French method on this experimental area shows a considerably lower production than under the regular Government method, but on the acre basis the yield of the French system is much higher. On timber suited to the system, and on an extensive operation where labor would be familiar with the method and would carry on chipping with regularity, there is reason to believe that the yield per face under the French method would compare more favorably with that under the Government system and produce a greater yield per square inch of exposed surface.

The chief virtues of the French system lie in the long period over which the operation can be conducted and in the fact that it may be applied to young growth and continued until the trees reach a size at which it is more profitable to cut them for saw timber. The time is rapidly approaching when the American gum naval-stores industry must depend to an ever increasing extent upon second-growth timber for its source of supply. In view of this fact, consideration of the French system is timely. The experiments on the Florida National Forest indicate that our second-growth longleaf pine can be profitably worked under this system. For the sake of the permanent welfare of the industry it would seem more than worth while for American operators in second-growth forests to adopt the governing principles of the French method.

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